

How to Block Nature's tendency to Order

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Discovering new states of matter is one of the primary goals of physics. Most matter orders at low temperatures. For example, water freezes, iron magnetizes, and helium becomes superfluid. In recent years physicists have begun to ask whether it is possible for matter not to order even at the lowest temperatures. It is widely believed that if such a state exists, it will possess many novel properties. For example, the electric charge may appear in lumps each carrying only a fraction of the electron's charge. In the past twenty years there has been an intensive search for this kind of state. However, the guideline for this search, "frustration" (i.e., the conflict between different ordering tendencies), has not been concrete enough to predict the condition(s) for the existence of uncondensed quantum states. Here we identify a new symmetry principle that protects a quantum state from ordering.